**Self Paced Wetland Ecology**

**Covers**: habitats, types of wetlands, humans and their environment, photosynthesis if needed

**Time**: at least one class before visit, one hour in the park, a class after the visit

**Background**: There is a glossary of wetland terms available at http://www.nps.gov/keaq/forteachers/upload/Definitionno.pdf

Wetlands are areas that have a regular flooding regime that determines the characteristics of the soil and plants that live there, and through them the wildlife. For different types of wetlands you can go to http://www.nps.gov/keaq/forteachers/types-of-wetlands.htm for types of wetlands and links to more information. Wetlands at Kenilworth tend to be tidal, areas submerged at high tide, and to a lesser degree at low tide. In addition at the beginning of the River Trail, there is a seasonal swamp that forms when we get enough water to raise the water table. Naturally, all of these are also affected by precipitation. All of the wetlands tolerate flooding, such as a hurricane, but a regular difference of an inch in average water depth can make a difference in what plants

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Wetlands have specialized soil characterized by anaerobic bacteria consuming organic matter that accumulates on the surface. Regular flooding prevents the build-up of oxygen in the soil. This leads to a prevalence of anaerobic bacteria that give wetlands that sour smell. These bacteria are important cycles of atoms. Wetlands, such as mud flats, fens, and bogs are places where an algae grows that incorporates an anaerobic bacteria in its cells. This bacteria species breaks down the nitrogen fertilizers we dump in the water, recombines the atoms, and releases nitrogen into the atmosphere where it stabilizes other gasses.

The aquatic plants that live in wetlands often have specialized cells in their stems called arenchyma cells that transport air. Like terrestrial plants they also have parenchyma cells to transport sugars and sap. These arenchyma cells move carbon dioxide and oxygen between the roots and leaves so the root doesn't rot. Google lotus bubbling video and you can see a lotus leaf releasing oxygen during photosynthesis.

Animals that live in the wetlands tend to be long legged birds and those that have broad feet or survive in low oxygen environments. They also tend to be small, mostly crustaceans. Because wetlands don't have much water movement, oxygen levels tend to be lower than fast moving streams.

For more on wetland characteristics go to http://www.nps.gov/keaq/forteachers/wetland-characteristics.htm

**Pre-visit research:** Have students research wetland functions at http://www.nps.gov/keaq/forteachers/wetland-functions.htm and determine which, if any, could be met by manufactured habitats or materials. Are there services society does not need.

Doing some research through EPA, the U.N. and other global environmental organizations, have students come up with an estimate of the percentage of wetlands left globally. Using a globe if possible find where the wetlands remaining are located. Looking at National Weather Service and other sources determine storm damage in areas with and without wetlands.

Use the tide chart link at http://www.saltwatertides.com/dynamic.dir/potomacsites.html to determine tide cycle for the date and time of your visit.

To get ready for their trip to the park: Locate the park on a Chesapeake Bay watershed map if you have one. If not you can show that the park is approximately in the middle of the north / south part of the Chesapeake Bay. From the research done, have students determine if the park will have any impact on the Chesapeake Bay.

Have students prepare a chart of types of wetlands at Kenilworth and their functions and descriptions like the one below or similar in function.

| | Impacted Swampy Area | Remnant Marsh | Built Marsh |
|---|---|---|---|
| Water depth<br>Tidal or not | | | |
| # plant types<br>(woody, floating,<br>grassy, broad<br>leaf) | | | |
| Suitable for fish?<br>Suitable for birds? | | | |
| If low tide, is there<br>evidence of sediment<br>trapping? | | | |

Have students bring the charts and something to write with when they come

**Note**: Explain: Since you won't be in the park for six hours, one way to tell if an area is tidal is to look for a flow to the water at high tide and look for a regular "mud signature" at low tide. The mud signature is mud that was in the water that has been trapped by the plants at high tide. This is mud that will build soil instead of going to the Chesapeake Bay to smother fish eggs and grasses. At high tide look at the mud content of the water and flow rate. If it is flowing slowly, students can surmise the mud will filter out to the bottom and fill in the wetland before it goes down stream to smother the Chesapeake Bay.

***In the park***

***Activity One: Wetland habitats and Variety***

Have students fill in their charts as they view different wetland types. The Impacted Wetland is the one where the path from the parking lot, a service road, and the pond road come together. The River Trail wetlands are not on the chart. Unless precision is a lesson, estimate water depth. The soft mud makes water depth hard to measure.

There are several places in the park to see wetlands. At the beginning of the River Trail on the right is a seasonal swamp. It forms when the water table is higher than the depression here. Along the river trail of the park the sea wall is being allowed to crumble and riparian wetlands are forming along the river behind the sea wall. These form when the river is low or slow moving, and are scoured out by floods.

Going counter clockwise around the pond road where the river trail, a service road, and the path from the parking lot come together there is a part of the swampy land that was here originally. This is being altered by beaver now (look for gnawed trees and ditches), and has seen an increase in flooding from run-off from the park maintenance area.

At the far end of that side of the ponds is a mud flat at low tide. This was engineered in a marsh construction in 1991. The beaver has ditched it, changing the hydrology. At low tide you can clearly see the ditch. In the late 1990s researchers found that mud flats like this one can be habitat to an algae that incorporates an anaerobic bacteria in its cells. This bacteria species takes the nitrogen from fertilizers out of the water and breaks down the atoms recombining them to atmospheric nitrogen and releases it to the atmosphere. As one of the inert gasses, nitrogen is an important stabilizing gas in the atmosphere. Across the mud flat near the River Tail is a part of the restoration that has expanded on its own. Siltation will eventually change the character of the mud flat, restoration and other areas to make them drier.

Continuing counter clock-wise just past the bench at the curve on the pond road is where the original marsh of Washington begins. Note the herbaceous character of this section. The water depth is almost three feet at high tide. This is the first part of this section to flood and the last to lose water as the tide goes out.

As you continue counter clockwise notice a change in the plants. There are semi woody plants growing on clumps of soil. These are often the crimson eye mallow, a plant that dies back in winter and resprouts from the root each summer. In fall the seed pods break into several beaked parts.

Just past the boardwalk, along the ponds, the hummocks get large enough for willow to survive, then there is a depression where marsh exists surrounded by swamp ( has trees). The difference is partly water depth, but the water depth affects the bacteria in the soil. Under anaerobic conditions, woody plants rot. They only live in aerobic or oxygenated soil. One determination of wetlands is based on the existence of aerobic or anaerobic bacteria in the soil. The bacteria impact the acidity and organic matter

of the soil. It may need to be pointed out that the remnant wetland area has a far higher degree of native biodiversity than the created wetlands. This is partly a function of age, but also of water depth and introduced pest plants that took advantage of the opening in the constructed wetland.

**Activity two: A Chesapeake Bay Experience**

Using their charts, fill in information about wetlands around the pond, but take a side trip out the boardwalk. Explain: On the boardwalk you can take a mini trip down the Chesapeake Bay. At the beginning of the boardwalk is a cattail marsh typical of shallow water with a high tide depth of less than six inches. As you walk out the boardwalk you will come to a tidal gut with shallow water that barely holds small fish at low tide, but is three feet deep at high tide. This is typical of the deep creeks and tidal shallows that characterize the Chesapeake Bay. At the first bump out deck on the left you are looking out at wetlands that may be a foot or more in depth at low tide, and three feet at high tide. This grassy looking area is typical of the lower parts of the Chesapeake. The park does not have brackish water or salt tolerant plants here so your class won't see these truly tough plants, some of which push salt our their stems.

At the beginning of the boardwalk look at the cattail marsh for signs of mud being trapped, such as muddy leaves, sediment on top of fallen leaves in the mud. This is mud that will stay here, filling in the cattail marsh over time. Listen and look for wildlife, most likely birds but could be frogs (park frogs do not go "ribbet". They make a variety of peeps, moans, snores, and plunks). Look for signs of animal tracks in the mud. These may be deer, geese, opossum, raccoon and fox. There are also a lot of mice. Look for predatory insects. Quickly make note of what students are seeing, hearing, and smelling. Is the marsh sour, earthy, or another odor?

Out at the tidal gut, what students see will very much depend on the tide phase. Have students determine if the tide is going in or out if the river is to the right as they go out. An easy way to tell is to drop a leaf in the water and see if it goes upstream to the left, or downstream to the right. Make a quick note on depth of the water at the time of their visit, distance across the tidal gut measured in feet of the boardwalk that crosses it.

Look for fish in the water. Even at low tide there will be some water coming out of the swamp upstream.

Have students do a quick count of the different types of plants they see, adding if they are herbaceous or woody. In addition, have one student per group if divided, do a sketch of the tidal gut.

At the first bump out platform again have students again count species, measure water depth at the time of their visit and look both in the circle formed by the platform and outside it for sedimentation evidence. This is mud that will stay here, filling in the marsh over time. Listen and look for wildlife, most likely birds but could be frogs (park frogs do not go "ribbet". They make a variety of peeps, moans, snores, and plunks). Look for signs of animal tracks in the mud. These may be deer, geese, opossum, raccoon and fox. There are also a lot of mice. Look for predatory insects. Quickly make note of what students are seeing, hearing, and smelling. Is the marsh sour, earthy, or another odor? Note how the

trees are growing. Are they scattered suggesting hummocks, or in a line suggesting a rise in the soil level of a bank?

**Post Visit**

Activity One

Looking at the charts completed, determine if the functions performed by the built marsh, the impacted marsh, and the remnant marsh are done to the same level. The restoration was done to clean water and improve or expand wildlife habitat. Would grade would they give that part of wetland? The remnant marsh is an area being looked at for the plants that can be changed and grown commercially in the drought and flooding expected with climate change in the next hundred years. What grade would they give that area for biodiversity?

Activity Two

Do the same analysis as for Activity One, but then look at the information gathered on the boardwalk.

Respond with a discussion on the value of the wetland area in modeling the Chesapeake Bay. Do the different areas represent an increase in over all wildlife habitat and water cleaning function over one type of wetland alone? If the students are used to working with volume, have them estimate the volume of water held in the tidal gut at a three foot high tide if the length of the gut is 500 feet out from the boardwalk toward the river. This much water is filtered by the marsh at the least every 13 hours. Do they feel this is enough to make an impact in the Chesapeake Bay water quality? How would they have attacked the problem of water quality if they were park ecologists?